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MICROWAVE LANDING SYSTEM (MLS) CHANNEL PLANS AND
TRAFFIC LOADING(U) ELECTROMAGNETIC COMPATIBILITY
ANALYSIS CENTER ANNAPOLIS MD A KOSAR ET AL 05 NOV 82
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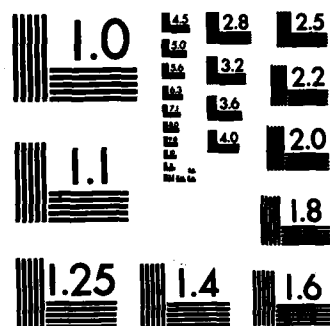
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ADDENDUM
Results

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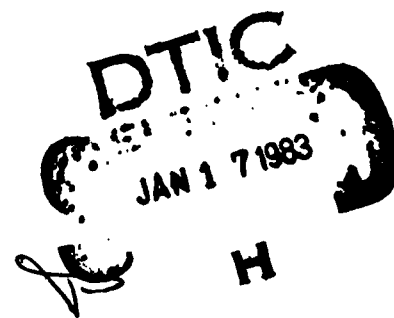
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Microwave Landing System (MLS) Channel Plans and Traffic Loading

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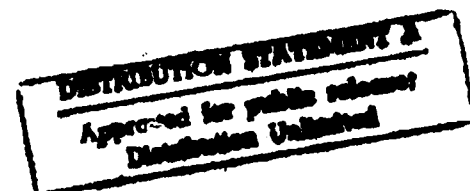


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Final Report

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ADDENDUM

Results

Revised Pulse Loading Determination (August 1982)

→ The magnitude of the maximum pulse loading situation within the STLM was reinvestigated based on the following change of inputs.

a) It was assumed that the victim transponder (previously defined as El Monte) in the STLM is replying at its maximum rate of 5000 pp/s. This required a redefinition of the aircraft within this service volume as follows:

Location	Number of A/C	Altitude (feet)	Interrogation Rate (pp/s)	Number of Interrogators
Ground	50	0	40	1
Final	6	below 2000	40	2
Intermediate	26	2000-4000	16	2
Stack	55	above 4000	16	2
Initial	55	above 4000	16	2

b) The uplink interrogator loading was calculated at distances of 22, and 7 nmi. The interrogator at 22 nmi was in the narrow band mode. At 7 nmi the interrogator was wide band. Beacon transponder squitter rates of 700 and 1350 will be used.

c) The following minimum uplink and downlink power density requirements was used:

<u>Uplink</u>	<u>Downlink</u>	<u>Distance</u>
-80 dBw/m ²	-83 dBw/m ²	7 nmi (wide band)
-87 dBw/m ²	-93 dBw/m ²	22 nmi (narrow band)

d) Receiver thresholds of -20, -14, -9, -6, 0, and +6 dB will be examined in both the uplink and downlink cases.



Accession For	DTIC GRAFI	DTIC TAB	Unannounced	Justification
By				
Distribution/				
Availability Codes				
Avail and/or				
Dist				
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e) Two blocks of channels from the Amsterdam channel plan was tested in the STLM. First, channels within 5 MHz of channel 24X; second, channels within 5 MHz of channel 90Y.

→ The results reflect two types of pulse loading interactions:

1. Undesired interrogations at a transponder from aircraft operating in a different service volume but transmitting on a frequency within the victim transponder's receiver bandwidth (air-to-ground loading).

2. Undesired replies and squitter received at an interrogator from a transponder servicing a different service volume but transmitting on a frequency within the victim interrogator's receiver bandwidth (ground-to-air loading).

↑
The interrogation loading on a transponder at El Monte, California, with the desired signal interrogator (aircraft) at 22 and 7 nmi for channels 24X and 90Y, respectively is provided in TABLES 5A, 5B, 6A, and 6B. The loading as noted in the tables is separated vertically into that which comes from cofrequency or adjacent-frequency undesired sources and whether the interfering interrogators are operating in the enroute or precision mode.^a The horizontal separation of the data in the tables reflects the relative power level between the desired and undesired interrogations at the transponder receiver input terminals. Note that with the exception of the one row marked "total individual pulses," the numbers in the tables represent interrogations not individual pulses.

If one considers an enroute/precision system, a transponder receiver with a relatively wide bandwidth (± 3.5 MHz) and with a -20 dB threshold level, the maximum number of individual air-to-ground pulses to be considered in a pulse loading analysis is 72,832 (see TABLE 5A). If the threshold level is higher

^aPrecision mode was assumed for aircraft in final approach within 7 nmi of the runway and those in takeoff.

than -20 dB (i.e., -18 dB), this maximum number would be a bit smaller, perhaps 71,592 as an estimate by interpolation.

The reply loading on an aircraft operating in the service volume of a DME/P transponder at El Monte, California, for various conditions of "demand loading" is provided in TABLES 10A through 13B. Demand loading refers to the potential for the idle reply rate of a transponder to be set at some value below 2700 replies/second (e.g., 1350 or 700), and that this reply rate would increase above that idle rate only when required in order to service additional aircraft in the service volume. The advantage of demand loading is that it could remove a significant amount of unnecessary squitter from the electromagnetic environment.

TABLES 10A through 13B are organized in a similar manner to TABLES 5A through 6B with the loading separated by that which comes from cofrequency or adjacent-frequency sources and also separated by relative desired- and undesired-signal power level at the interrogator input terminals. Note that in TABLES 10A through 13B, the loading numbers represent replies and squitter, not individual pulses, with the exception of the last row marked "total individual pulses."

The data reflected in TABLES 10A through 13B indicates that for an enroute/precision system, an interrogator with a relatively wide bandwidth while operating in the precision mode (± 3.5 MHz) and with a -20 dB threshold level while in final approach or takeoff, the maximum number of individual ground-to-air pulses to be considered in a pulse loading analysis is 107,100 pulses per second (see TABLE 10A) when demand loading is not considered. If a demand loaded DME/P system is introduced throughout the STLM, with an idle reply rate of 700 replies/second, the pulse-loading situation reduces to 79,800 pulses per second (see TABLE 12A). This situation is somewhat less severe for an aircraft operating in the same service volume but in the enroute mode (i.e., narrower bandwidth, higher threshold).

TABLE 5A
AIR-TO-GROUND (INTERROGATION) LOADING AT A TRANSPONDER
FOR A DESIRED-SIGNAL INTERROGATOR AT 22 nmi (± 4 MHz ABOUT 24X)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second					
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6
Cofrequency	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	8384	7968	7616	7280	6528	6016
	DME/P-Precision	4160	4080	3840	3840	3600	2640
± 1 MHz	DME/N-En route	1350	1290	1200	1050	810	660
	DME/P-En route	4448	3744	2784	1952	928	448
	DME/P-Precision	800	640	560	560	480	320
± 2 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	6016	5680	4656	3936	2192	1088
	DME/P-Precision	960	880	480	480	240	0
± 3 MHz	DME/N-En route	2220	2070	1830	1710	1500	1200
	DME/P-En route	864	864	816	816	512	320
	DME/P-Precision	240	240	160	160	80	0
± 4 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	4896	4640	4224	3808	3232	2624
	DME/P-Precision	2080	1840	1760	1760	1680	720
Total Interrogation	DME/N-En route	3570	3360	3030	2760	2310	1860
	DME/P-En route	24606	22896	20096	17792	13392	10496
	DME/P-Precision	8240	7680	6800	6800	6080	3680
Total Individual Pulses ^c		72832	67872	59852	54704	43564	32072

^aInterfering interrogator type and mode; conventional DME/N; MLS DME/P.

^bNumbers of interrogations greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming all aircraft in final approach or takeoff are operating in the precision mode and transmitting 3 pulses per interrogation.

TABLE 5B
AIR-TO-GROUND (INTERROGATION) LOADING AT A TRANSPONDER
FOR A DESIRED-SIGNAL INTERROGATOR AT 22 nmi (± 4 MHz ABOUT 90Y)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second					
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6
Cofrequency	DME/N-En route	840	660	390	270	90	0
	DME/P-En route	6080	5952	5952	5952	5824	5440
	DME/P-Precision	3440	3440	3280	3280	3120	2480
± 1 MHz	DME/N-En route	2790	2700	2460	2130	1650	1320
	DME/P-En route	1648	1280	912	736	512	320
	DME/P-Precision	240	240	160	160	80	0
± 2 MHz	DME/N-En route	1320	1260	780	630	240	180
	DME/P-En route	2560	2304	1664	1024	288	128
	DME/P-Precision	560	400	400	400	400	160
± 3 MHz	DME/N-En route	2520	2370	2250	1950	1650	1320
	DME/P-En route	2368	2304	2176	1984	1248	704
	DME/P-Precision	640	560	320	320	160	0
± 4 MHz	DME/N-En route	1590	1320	810	480	150	60
	DME/P-En route	4688	4544	4336	4032	3184	2432
	DME/P-Precision	1840	1680	1440	1440	1280	480
Total Interrogation	DME/N-En route	9060	8310	6690	5460	3780	2880
	DME/P-En route	17344	16384	15040	13728	11056	9024
	DME/P-Precision	6720	6320	5600	5600	5040	3120
Total Individual Pulses ^c		66248	62028	54660	49576	39752	30048

^aInterfering interrogator type and mode: conventional DME/N; MLS DME/P.

^bNumbers of interrogations greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming all aircraft in final approach or takeoff are operating in the precision mode and transmitting 3 pulses per interrogation.

TABLE 6A

**AIR-TO-GROUND (INTERROGATION) LOADING AT A TRANSPONDER
FOR A DESIRED-SIGNAL INTERROGATOR AT 7 nm1 (± 4 MHz ABOUT 24X)**

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second					
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6
Cofrequency	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	8512	7280	6624	6016	4048	1232
	DME/P-Precision	3840	3840	3600	2640	2640	2160
± 1 MHz	DME/N-En route	900	870	690	600	390	180
	DME/P-En route	2912	2048	800	288	128	16
	DME/P-Precision	480	480	400	160	160	0
± 2 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	4656	3936	2192	1088	416	32
	DME/P-Precision	480	480	240	0	0	0
± 3 MHz	DME/N-En route	1800	1710	1500	1200	900	570
	DME/P-En route	816	752	512	320	96	0
	DME/P-Precision	160	160	80	0	0	0
± 4 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	4256	3808	3232	2624	2320	1088
	DME/P-Precision	1760	1760	1680	720	720	240
Total Interrogation	DME/N-En route	2700	2580	2190	1800	1290	750
	DME/P-En route	2452	17824	13360	10336	7008	2368
	DME/P-Precision	6720	6720	6000	3520	3520	2400
Total Individual Pulses ^c		61144	54248	43100	31312	23636	11036

^aInterfering interrogator type and mode: conventional DME/N; MLS DME/P.

^bNumbers of interrogations greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming all aircraft in final approach or takeoff are operating in the precision mode and transmitting 3 pulses per interrogation.

TABLE 6B
AIR-TO-GROUND (INTERROGATION) LOADING AT A TRANSPONDER
FOR A DESIRED-SIGNAL INTERROGATOR AT 7 nmi (± 4 MHz ABOUT 90Y)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	360	270	90	0	0	0	
	DME/P-En route	5952	5952	5824	5440	3680	1152	
	DME/P-Precision	3280	3280	3120	2480	2480	2160	
± 1 MHz	DME/N-En route	2280	2070	1650	320	870	420	
	DME/P-En route	1184	896	448	160	32	0	
	DME/P-Precision	80	80	0	0	0	0	
± 2 MHz	DME/N-En route	780	630	360	180	60	0	
	DME/P-En route	1216	768	224	128	96	48	
	DME/P-Precision	400	400	400	160	160	0	
± 3 MHz	DME/N-En route	1200	1200	1140	840	690	480	
	DME/P-En route	2176	1984	1248	704	320	32	
	DME/P-Precision	320	320	160	0	0	0	
± 4 MHz	DME/N-En route	540	330	120	30	0	0	
	DME/P-En route	4336	4032	3184	2432	1888	768	
	DME/P-Precision	1440	1440	1280	480	480	160	
Total Interrogation	DME/N-En route	5160	4500	3360	2370	1620	900	
	DME/P-En route	14864	13632	10480	8704	6016	2000	
	DME/P-Precision	5520	5520	4960	3120	3120	2320	
Total Individual Pulses ^c		51088	47304	37600	28388	21512	10440	

^aInterfering interrogator type and mode: conventional DME/N; MLS DME/P.

^bNumbers of interrogations greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming all aircraft in final approach or takeoff are operating in the precision mode and transmitting 3 pulses per interrogation.

TABLE 10A
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 22 nmi (± 4 MHz ABOUT 24X)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 1350 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	4860	2916	2916	1944	1944	1944	1944
	DME/P-Precision	1890	1134	1134	756	756	756	756
± 1 MHz	DME/N-En route	10800	10800	10800	10800	10800	10800	10800
	DME/P-En route	0	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0	0
± 2 MHz	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	9720	9720	6804	2976	2916	7944	7944
	DME/P-Precision	3780	3780	2646	1134	1134	756	756
± 3 MHz	DME/N-En route	14400	14400	14400	14400	14400	10800	10800
	DME/P-En route	0	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0	0
± 4 MHz	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	5832	5832	4860	4860	2916	2916	2916
	DME/P-Precision	2268	2268	1890	1890	1134	1134	1134
Total Interrogation	DME/N-En route	25200	25200	25200	25200	25200	21600	21600
	DME/P-En route	20412	18468	14580	9720	7776	6804	6804
	DME/P-Precision	7938	7182	5670	3780	3024	2646	2646
Total Individual Pulses ^c		107100	101700	90900	77400	72000	62100	62100

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 10B

GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 22 nmi (± 4 MHz ABOUT 90Y)
 (Assuming an Unloaded DME/N Transponder Reply Rate of
 3600 Replies/Second for TACAN and 2700 Replies for
 VOR-DME and an Unloaded DME/P Transponder Reply Rate
 of 1350 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	3888	2916	2916	972	972	972	
	DME/P-Precision	1512	1134	1134	378	378	378	
± 1 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	9720	8748	6804	5832	4860	4860	
	DME/P-Precision	3780	3402	2646	2268	1890	1890	
± 2 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	9720	9720	8748	3888	2916	1944	
	DME/P-Precision	3780	3780	3402	1512	1134	756	
± 3 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	6804	6804	4860	3888	3888	3888	
	DME/P-Precision	2646	2646	1890	1512	1512	1512	
± 4 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	5832	5832	5832	4860	3888	3888	
	DME/P-Precision	2268	2268	2268	1890	1512	1512	
Total Interrogation	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	35964	34020	29160	19440	16524	15552	
	DME/P-Precision	13986	13230	11340	7560	6426	6048	
Total Individual Pulses ^c		99900	94500	81000	54000	45900	43200	

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 11A
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 7 nmi (± 4 MHz ABOUT 24X)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 1350 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second					
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6
Cofrequency	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	4860	3888	3888	2916	972	972
	DME/P-Precision	1890	1512	1512	1134	378	378
± 1 MHz	DME/N-En route	10800	10800	10800	10800	7200	7200
	DME/P-En route	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0
± 2 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	5832	2916	972	972	0	0
	DME/P-Precision	2268	1134	378	378	0	0
± 3 MHz	DME/N-En route	7200	7200	7200	7200	7200	7200
	DME/P-En route	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0
± 4 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	3888	2916	1944	1944	1944	1944
	DME/P-Precision	1512	1134	756	756	756	756
Total Interrogation	DME/N-En route	18000	18000	18000	18000	14400	14400
	DME/P-En route	14580	9720	6804	5832	2916	2916
	DME/P-Precision	5670	3780	2646	2268	1134	1134
Total Individual Pulses ^c		76500	63000	45450	261000	316900	36900

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (p) whenever they are interrogated with 3 pulses (aircraft in final a, each or takeoff).

TABLE 11B
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 7 nmi (± 4 MHz ABOUT 90Y)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 1350 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	2916	972	972	972	0	0	
	DME/P-Precision	1134	378	378	378	0	0	
± 1 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	5832	3888	2916	1944	0	0	
	DME/P-Precision	2268	1512	1134	756	0	0	
± 2 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	8748	2916	0	0	0	0	
	DME/P-Precision	3402	1134	0	0	0	0	
± 3 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	4860	3888	3888	3888	3888	388	
	DME/P-Precision	1890	1512	1512	1512	1512	1512	
± 4 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	5832	3888	1944	972	972	972	
	DME/P-Precision	2268	1512	756	378	378	378	
Total Interrogation	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	28188	15552	9720	7776	4860	4860	
	DME/P-Precision	10964	6048	3780	3024	1890	1890	
Total Individual Pulses ^c		78300	43200	27000	21600	13500	13500	

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 12A
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 22 nmi (± 4 MHz ABOUT 24X)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 700 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	2205	1323	1323	882	882	882	882
	DME/P-Precision	1295	777	777	518	518	518	518
± 1 MHz	DME/N-En route	10800	10800	10800	10800	10800	10800	10800
	DME/P-En route	0	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0	0
± 2 MHz	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	4410	4410	3087	1323	1323	882	882
	DME/P-Precision	2590	2590	1813	777	777	518	518
± 3 MHz	DME/N-En route	14400	14400	14400	14400	14400	10800	10800
	DME/P-En route	0	0	0	0	0	0	0
	DME/P-Precision	0	0	0	0	0	0	0
± 4 MHz	DME/N-En route	0	0	0	0	0	0	0
	DME/P-En route	2646	2646	2205	2205	1323	1323	1323
	DME/P-Precision	1554	1554	1295	1295	777	777	777
Total Interrogation	DME/N-En route	25200	25200	25200	25200	25200	21600	21600
	DME/P-En route	9261	8379	6615	4410	3528	3087	3087
	DME/P-Precision	5439	4921	3885	2590	2072	1813	1813
Total Individual Pulses ^c		79800	77000	71400	64400	61600	53000	53000

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 12B
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 22 nmi (± 4 MHz ABOUT 90Y)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 700 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	1764	1323	1323	441	441	441	
	DME/P-Precision	1036	777	777	259	259	259	
± 1 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	4410	3969	3087	2646	2205	2205	
	DME/P-Precision	2590	2331	1813	1554	1295	1295	
± 2 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	4410	4410	3969	1764	1323	882	
	DME/P-Precision	2590	2590	2331	1036	777	518	
± 3 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	3087	3087	2205	1764	1764	1764	
	DME/P-Precision	1813	1813	1295	1036	1036	1036	
± 4 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	2646	2646	2646	2205	1764	1764	
	DME/P-Precision	1554	1554	1554	1295	1036	1036	
Total Interrogation	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	16317	15435	13230	8820	7497	7056	
	DME/P-Precision	9583	9065	7770	5180	4403	4144	
Total Individual Pulses ^c		51800	49000	42000	28000	23800	22400	

^a Interfering transponder type and mode.

^b Numbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^c Assuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 13A
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 7 nmi (± 4 MHz ABOUT 24X)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 700 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second						
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6	
Cofrequency	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	2205	1036	1036	1323	441	441	
	DME/P-Precision	1295	1764	1764	777	259	259	
± 1 MHz	DME/N-En route	10800	10800	10800	10800	7200	7200	
	DME/P-En route	0	0	0	0	0	0	
	DME/P-Precision	0	0	0	0	0	0	
± 2 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	2646	1323	441	441	0	0	
	DME/P-Precision	1554	777	259	259	0	0	
± 3 MHz	DME/N-En route	7200	7200	7200	7200	7200	7200	
	DME/P-En route	0	0	0	0	0	0	
	DME/P-Precision	0	0	0	0	0	0	
± 4 MHz	DME/N-En route	0	0	0	0	0	0	
	DME/P-En route	1764	1323	882	882	882	882	
	DME/P-Precision	1036	777	518	518	518	518	
Total Interrogation	DME/N-En route	18000	18000	18000	18000	14400	14400	
	DME/P-En route	6615	3682	2359	2646	1323	1323	
	DME/P-Precision	3885	3318	2541	1554	777	777	
Total Individual Pulses ^c		57000	50000	45800	44400	33000	33000	

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

TABLE 13B
GROUND-TO-AIR (REPLY) LOADING OF AN AIRCRAFT AT 7 nmi (± 4 MHz ABOUT 90Y)
(Assuming an Unloaded DME/N Transponder Reply Rate of
3600 Replies/Second for TACAN and 2700 Replies for
VOR-DME and an Unloaded DME/P Transponder Reply Rate
of 700 Replies/Second)

Relative Frequency	Interrogator Type-Mode ^a	Number of Interrogations ^b Per Second					
		U/D > -20	U/D > -14	U/D > -9	U/D > -6	U/D > +0	U/D > +6
Cofrequency	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	1323	441	441	441	0	0
	DME/P-Precision	777	259	259	259	0	0
± 1 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	2646	1764	1323	882	0	0
	DME/P-Precision	1554	1036	777	518	0	0
± 2 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	3969	1323	0	0	0	0
	DME/P-Precision	2331	777	0	0	0	0
± 3 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	2205	1764	1764	1764	1764	1764
	DME/P-Precision	1295	1036	1036	1036	1036	1036
± 4 MHz	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	2646	1764	882	441	441	441
	DME/P-Precision	1554	1036	518	259	259	259
Total Interrogation	DME/N-En route	0	0	0	0	0	0
	DME/P-En route	12789	7056	4410	3528	2205	2205
	DME/P-Precision	7511	4144	2590	2092	1295	1295
Total Individual Pulses ^c		40600	22400	74000	11200	7000	7000

^aInterfering transponder type and mode.

^bNumbers of replies greater than or equal to an undesired-to-desired signal power ratio (U/D) of -20, -9, -6 dB, etc., are represented in each column.

^cAssuming that DME/P transponders reply with 3 pulses (precision mode) whenever they are interrogated with 3 pulses (aircraft in final approach or takeoff).

